

INTAKE SYSTEM FOR INTERNAL COMBUSTION ENGINE

BACKGROUND OF THE INVENTION

CROSS-REFERENCE TO RELATED APPLICATIONS

[001] The present non-provisional application claims priority under 35 USC 119 to Japanese Patent Application No. 2002-196783 filed on July 5, 2002 the entire contents thereof is hereby incorporated by reference.

Field of the Invention

[002] The present invention relates to an intake system for an internal combustion engine. More particularly, to an improvement in an intake system for internal combustion engine in which a partition wall for modifying the inflow characteristic of a mixture of gas supplied into an intake port to a predetermined condition is replaceably mounted in an intake port opening, and the inflow characteristic of the mixture of gas is modified from the predetermined condition to another condition, whereby the output characteristic of the internal combustion engine is appropriately regulated, thereby giving an optimum vehicle operating characteristic.

Description of Background Art

[003] Hitherto, as an intake system of a 4-stroke cycle internal combustion engine, there has been known a technology in which the inflow characteristic of a mixture of gas supplied is controlled to a special condition, thereby to achieve an enhancement in the combustion efficiency in the internal combustion engine and an improvement in the exhaust gas characteristics.

[004] For example, Japanese Patent Laid-open No. Hei 11-166420 discloses a technology in which an intake passage on the downstream side of a throttle valve is partitioned by a partition wall into upper and lower portions as a high-load passage and a low-load passage, and at the time of low load when the opening of the throttle valve is small, the mixture of gas flows in from the low-load passage along an intake port upper wall of a cylinder head, whereby a tumble due to intake gas is generated in the cylinder, and stirring of the mixture of gas is promoted, thereby achieving stabilization of combustion and an improvement in the exhaust gas characteristics at the time of the low-load operation.

[005] In addition, Japanese Patent Laid-open No. 2000-145467 discloses a technology in which a tumble composed of circular streams flowing in two directionalities is generated in the cylinder due to a mixture of gas and air flowing into the cylinder via an intake outlet, thereby contriving stabilization of combustion at the time of low-load operation, and the mixture of gas flows through a high-load passage and a low-load passage, whereby the mixture of gas is supplied via the intake outlet of an intake port into the cylinder in a large quantity, thereby contriving enhancement of output at the time of high-load operation.

[006] This prior art relates to an internal combustion engine with a high intake

efficiency and an enhanced output, in which the inflow characteristic of the mixture of gas is controlled to a special condition, whereby the combustion efficiency in the cylinder is improved, thereby contriving enhancement of the output characteristic of the internal combustion engine. As a result, an enhancement in the operating characteristics of the vehicle is contrived by an improvement in fuel consumption in the internal combustion engine and an improvement in the output characteristics of the engine.

[007] Meanwhile, the operating characteristics of the vehicle vary depending on differences in operating conditions in the operating of the vehicle, even if there is no difference in the output characteristic itself of the engine of the vehicle. For example, the operating characteristics vary depending on differences in the road conditions and the rider's driving skill. Particularly, variations in the road conditions are diverse ranging from a slippery road surface at the times of rainfall, snowfall and road surface freezing to a dried-out road surface condition at the time of fine weather, and the rider's driving skill varies greatly from person to person. Thus, the operating characteristics of the vehicle vary greatly depending on variations and differences in the various conditions attendant on the operating of the vehicle. Accordingly, it is desired to develop and improve an internal combustion engine that can be changed in the specifications thereof according to the variations and differences in the various conditions in the operating of the vehicle, i.e., the road conditions, driving skill, etc.

[008] From the viewpoint of the prior art referred to above, the development and improvement of technology according to the prior art resides in the enhancement of the operating characteristics of the vehicle that is contrived through an improvement in the output characteristic of the internal combustion engine, as described above.

However, the prior art does not take into consideration the measure to cope with variations and differences in the various conditions in the operating of the vehicle.

[009] For example, referring to the above-mentioned points from the structural features of the internal combustion engine according to the prior art, in the prior art the special control of the inflow characteristic of the mixture of gas sucked into the cylinder is performed by the partition wall provided in the intake passage as a fixed structure, the special control of the inflow characteristic of the mixture of gas is utterly invariable on a structural basis, the control of the inflow characteristic of the mixture of gas is always conducted under fixed conditions, and the regulation of the output characteristic of the internal combustion engine is conducted under fixed conditions. Thus, the specifications of the engine are not modified according to variations and differences in the various conditions in the operating of the vehicle.

[0010] Therefore, in the above-mentioned situations, it is desired to develop and improve an internal combustion engine having specifications that can be modified for coping with variations and differences in the various conditions on the operating of the vehicle, namely, various modified conditions on the operating of the vehicle. In practice, however, the development and improvement of such an internal combustion engine are difficult to achieve due to an increase in cost, and it is being desired to find a good measure to improve the internal combustion engine which makes it possible to meet the above-mentioned request by a simple structural modification and at low cost. At present, however, there has not been found any good measure to meet the above request.

SUMMARY AND OBJECTS OF THE INVENTION

[0011] The present invention, in the above-mentioned situations, provides a measure to meet the above request, and provides an improving technology for the internal combustion engine that has specifications capable of being modified for coping with various modified conditions on the operating of the vehicle by a simple structural modification of the internal combustion engine and at low cost. According to the present invention, there is provided an intake system for an internal combustion engine, that includes at least two intake valves, a passage through which a mixture of gas is supplied to each of the intake valves, a passage separating partition wall provided in the passage for supplying each of the mixture of gas respectively to each of the intake valves, and an intake port opening into which the mixture of gas is taken in so as to supply the mixture of gas into the passage, wherein a partition wall for bisecting the intake port opening is mounted in the intake port opening oppositely to the passage partition wall for supplying each of the mixture of gas respectively to each of the intake valves, in such a manner as to be replaceable with other partition wall.

[0012] According to the present invention, there is provided an intake system for an internal combustion engine, including at least two intake valves, a passage through which a mixture of gas is supplied to each of the intake valves, a passage separating partition wall provided in the passage for supplying each of the mixture of gas respectively to each of the intake valves, and an intake port opening into which the mixture of gas is taken in so as to supply the mixture of gas into the passage, wherein a partition wall for bisecting the intake port opening is mounted in the intake port opening oppositely to the passage partition wall for supplying each of the mixture of gas respectively to each of the intake valves, in such a manner as to be replaceable

with another partition wall. Therefore, with the partition wall replaced with another partition wall as required, the inflow characteristic of the mixture of gas taken in through the intake port opening is modified by the partition wall, and, with the mixture of gas supplied into the cylinder of the internal combustion engine, regulation of the combustion condition is contrived, whereby the output characteristic of the internal combustion engine is regulated so as to give a desired appropriate vehicle operating characteristic.

[0013] According to the present invention, the partition wall replaceably mounted so as to bisect the intake port opening is composed of one of plates differing from each other in length. Therefore, in addition to the effects of the present invention as described above, the inflow characteristic of the mixture of gas can be easily modified because the length of the partition wall bisecting the intake port opening is changed by replacement of the plate, and the mounting of the partition wall and handling of the partition wall are easy because the structure for mounting the partition wall into the intake port opening consists in mounting of the plate.

[0014] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The present invention will become more fully understood from the detailed

description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

[0016] Fig. 1 shows a cylinder head portion of an internal combustion engine according to the present invention;

[0017] Fig. 2 is a sectional view taken along line A-A of Fig. 1 according to the present invention;

[0018] Fig. 3 shows the cylinder head portion according to the present invention, as viewed in the direction of arrow B;

[0019] Figs. 4(a) to 4(e) shows a plate according to the present invention; and

[0020] Fig. 5 is a diagram showing the relationships between the plate reduction amount and the torque feeling and power feeling according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Now, an embodiment of the present invention will be described below based on the drawings.

[0022] Fig. 1 shows a cylinder head 10 of an internal combustion engine as viewed from above. In the cylinder head 10, two intake valves 1g and 1h and two exhaust valves 1j and 1k are shown. In addition, an igniter 1m is shown between the intake valves 1g, 1h and the exhaust valves 1j, 1k. Further, as illustrated to the right portion of Fig. 1, an in-intake-port passage 1c is in communication with the two intake valves 1g, 1h, and an intake port opening 1a which is an inlet to the passage 1c.

[0023] A mixture of gas flowing from a throttle valve of a carburetor not shown flows in through the intake port opening 1a. The mixture of gas is led through the in-

intake-port passage 1c and the two intake valves 1g, 1h into the cylinder not shown. The in-intake-port passage 1c extends as a single passage with a predetermined length from the intake port opening 1a, and is branched into two branch passages 1d and 1e by a partition wall 1f disposed at a predetermined position in the passage 1c. The mixture of gas is led through the two branch passages 1d and 1e respectively to the two intake valves 1g and 1h.

[0024] In addition, as shown in Figs. 1 to 3, the intake port opening 1a is provided with groove portions 1b for a plate P constituting a partition wall A with a predetermined length for separating the opening 1a into left and right portions. A pair of the groove portions 1b are provided at upper and lower symmetrical positions of the intake port opening 1a so that the opening 1a is separated into left and right portions by the partition wall constituted of the plate P. Each of the pair of groove portions 1b extends over a predetermined distance from an end of the opening 1a to the inside of the in-intake-port passage 1c.

[0025] The plate P for constituting the partition wall A is appropriately formed of a plate material such as a steel plate having a predetermined thickness. As shown in Fig. 4(a), the plain surface shape of the plate P consists of a base straight line portion P1 in a straight line form, a pair of parallel straight line extended portion P2 extend as parallel straight line portions with a predetermined length from both ends of the straight line portion P1, and a roughly arcuate curved line portion P3 through which the respective tip ends of the pair of parallel straight line extending portions P2 are connected to each other. The plate P is a plate form body having an overall circumferential length of L_p .

[0026] The insertion and holding of the plate P are conducted by inserting the pair

of parallel straight line extended portions 2 into the upper-lower pair of opposite groove portions 1b provided in the intake port opening 1a so that the side of the roughly arcuate curved line portion P3 of the plate P is the leading end that is inserted. The insertion of the plate P is carried out until the base straight line portion P1 becomes flush with the opening end of the intake port opening 1a. Thereafter, the plate P is fixed by an appropriate fixing means not shown, whereby the plate P is held in the inserted condition.

[0027] The plate P thus inserted and held can be detached for replacement thereof with another plate P. In this meaning, the fixation of the plate P by the fixing means is not permanent fixation. However, in the fixed condition of the plate P, it must be ensured that the mounting position of the plate P would not be staggered and the plate P would not be disengaged due to a slackening generated by vibration of the internal combustion engine or the like.

[0028] Now, the plate P in the embodiment of the present invention will be described more in detail below.

[0029] The plate P is formed by working a steel plate or the like with an appropriate thickness by a working means such as stamping, and the plain surface shape thereof has the above-mentioned shape shown in Fig. 4(a). The plate P shown in Fig. 4(a) is a plate having a predetermined length L_p . With the plate P_0 in which the length L_p of the plate P is L_0 as a standard, the plate P_0 is cut to an appropriate length for obtaining an engine output characteristic controlled to a desired appropriate condition, namely, to each of lengths indicated by dotted lines in Fig. 4(a), for example, each of lengths $L_a, L_b, L_c, \dots L_n$ to be used as each of plates $P_a, P_b, P_c, \dots P_n$, as illustrated in Figs. 4(b) to 4(e). Alternatively, the plate P_0 is not cut and is used

as the plate P_0 as it has the length L_0 .

[0030] Therefore, each of the plates $P_a, P_b, P_c, \dots P_n$ shown in Figs. 4(b) to 4(e) and the plate P_0 not directly shown in Figs. 4(b) to 4(e) is the plate P prepared for obtaining the desired engine output characteristic. The plate P_0 is the plate P which has not been cut, and each of the plates $P_a, P_b, P_c, \dots P_n$ is a plate P which has been formed by cutting the plate P_0 as the standard to a predetermined length.

[0031] The respective lengths $L_0, L_a, L_b, L_c, \dots L_n$ of the plates P are appropriately set based on the relationships between the plate reduction amount (cutting amount of the plate P , more precisely, the cutting amount for the plate P_0 constituting the standard) and the torque feeling and power feeling in the operating of the vehicle which are shown in Fig. 5 and will be detailed later.

[0032] The plates P in the embodiment of the present invention have the structure as described above, and are used in correspondence with various modified conditions on the operating of the vehicle as described above. Specifically, correspondingly to the modified conditions, an appropriate correlationship with the torque feeling and power feeling corresponding to the conditions is selected, and a plate length L_p based on the selection is set. For example, one of the plate lengths $L_a, L_b, L_c, \dots L_n$ and further L_0 and the like is set, and the plate $P_a, P_b, P_c, \dots P_n$ or P_0 or the like corresponding to the set length is used. One plate having a predetermined length is selected from among the set-length plates $P_a, P_b, P_c, \dots P_n$, the selected plate is mounted in the intake port opening 1a of the internal combustion engine, and the inflow characteristic of the mixture of gas sucked in through the opening 1a is modified by the plate P having the predetermined length, whereby regulation of the combustion condition in the cylinder is contrived, and the output characteristic of the

internal combustion engine is set to an engine specification corresponding to the modified conditions.

[0033] Namely, the partition wall A is constituted of the plate P mounted in the intake port opening 1a, the inflow characteristic of the mixture of gas sucked in through the opening 1a is modified by the partition wall A, or by the plate P having the predetermined length, whereby regulation of the combustion condition in the cylinder is contrived, and the output characteristic of the internal combustion engine is regulated. Thus, there is obtained an internal combustion engine whose specifications are modified correspondingly to the various modified conditions on the operating of the vehicle.

[0034] Meanwhile, a detailed description of the setting of the length of the plate P has not yet been made. Here, the setting of the length of the plate P will be described based on Fig. 5.

[0035] The relationships between the length of the plate P mounted in the intake port opening 1a and the torque feeling and power feeling at the time of operating of the vehicle obtained from the variation in the output characteristic of the internal combustion engine, i.e., the relationships between the variation in the length of the plate P and the variations in the torque feeling and power feeling at the time of operating of the vehicle obtained from the output characteristic of the internal combustion engine upon the variation in the plate length are clearly described based on Fig. 5 which is based on the data obtained by the present inventors. Both types of quantities are in the following relationships.

[0036] Namely, Fig. 5 shows the correlations between the length of the plate P expressed as a plate reduction amount, i.e., the cutting amount for the plate P_0 with the

length L_0 constituting the standard and the torque feeling and power feeling at the time of operating of the vehicle obtained from the characteristic of the internal combustion engine. The torque feeling and power feeling in Fig. 5 express the torque intensity and power intensity obtained from the feelings of the operator obtained by the operator during operating of the vehicle. In the five levels of rating, 5.0 indicates excellent, 4.0 indicates good, 3.0 indicates average, 2.0 indicates poor, and 1.0 indicates ng, not acceptable.

[0037] Fig. 5 shows how the torque feeling and power feeling vary according to the change in the reduction amount of the plate P, i.e., according to the change in the setting of the length of the plate P. The length of the plate P for obtaining the desired torque feeling and power feeling is set based on Fig. 5.

[0038] In other words, it is shown that the desired torque feeling and power feeling can be obtained by use of the plate P having the set length.

[0039] As is clear from Fig. 5, when the plate P_0 with the length L_0 is used, the torque feeling is 4.5 and the power feeling is 4.0. With this as a standard, when the plate reduction amount is in the vicinity of 15 mm, i.e., when the plate length is shorter than the length of the plate P_0 by 15 mm, the torque feeling is 3.75 and the power feeling is 3.5. When the plate reduction amount is in the vicinity of 30 mm, i.e., when the plate length is shorter than the length of the plate P_0 by 30 mm, the torque feeling is 2.75 and the power feeling is 3.75. When the plate length is shorter than the length of the plate P_0 by 45 mm, the torque feeling is 2.5 and the power feeling is 3.75.

[0040] The overall tendency of the relationships between the plate reduction amount and the torque feeling and power feeling is as follows. Until the reduction

amount reaches the vicinity of 15 mm, the torque feeling and power feeling tend to decrease with an increase in the reduction amount. When the reduction amount is in the range from 15 mm to about 20 mm, the torque feeling decreases rapidly. Thereafter, the torque feeling maintains a value of about 2.5. The power feeling varies a little when the reduction amount is in the range of 15 mm to about 20mm. Thereafter, the power feeling is at an intermediate value between about 3.5 and 4.0.

[0041] Since the relationships between the length L_p of the plate P mounted in the intake port opening 1a and the torque feeling and power feeling at the time of operating of the vehicle obtained from the feelings of the rider are as described above, in correspondence with the various modified conditions on the operating of the vehicle, appropriate torque feeling and power feeling corresponding to the conditions are appropriately selected based on Fig. 5.

[0042] Then, the plate reduction amount, or the cutting amount for the plate P_0 constituting the standard, based on the selection of the torque feeling and power feeling is determined, the plate P with the length L_p corresponding to the cutting amount is set, and the plate P with the set length is mounted in the intake port opening 1a.

[0043] Namely, in correspondence with the road conditions and differences in the operator's driving skill and the like, i.e., in correspondence with various modified conditions on the operating of the vehicle such as a slippery road surface condition due to rainfall, snowfall, freezing or the like, a dried-out road surface condition, and the operator's driving skill, optimum torque feeling and power feeling corresponding to the conditions are selected based on Fig. 5.

[0044] The torque feeling and power feeling are selected, the length L_p of the

plate member P to be mounted in the intake port opening 1a of the engine is set from the plate reduction amount based on the selection, and the plate P with the set length is mounted in the intake port opening 1a, whereby the output characteristic of the engine is regulated appropriately.

[0045] Since the embodiment shown in Figs. 1 to 5 of the present invention is constituted as described above, in correspondence with various modified conditions on the operating of the vehicle, appropriate torque feeling and power feeling corresponding to the conditions are selected, the reduction amount of the plate P attendant on the selection is determined from Fig. 5, the plate P_0 constituting the standard is cut according to the reduction amount or is not cut to be set as the plate P_a , P_b , P_c , ... P_n or P_0 with a predetermined length L_a , L_b , L_c , ... L_n or L_0 , and the plate P thus set is mounted in the intake port opening 1a of the internal combustion engine, whereby the partition wall A is formed in the opening 1a, the inflow characteristic of the mixture of gas sucked in through the opening 1a is modified by the partition wall A, and the output characteristic of the internal combustion engine is regulated appropriately. In this manner, an internal combustion engine capable of being modified in specification correspondingly to the various modified conditions on the operating of the vehicle can be provided.

[0046] A variety of embodiments may be contemplated in place of the above-described embodiment.

[0047] While the plate P has been formed of a steel plate or the like in the above embodiment, the plate P may be formed of other metallic material, for example, a plate material of a comparatively lightweight metal such as aluminum and an aluminum alloy, or may be formed by use of a plate material of a resin having a high

thermal resistance or the like.

[0048] While the plate P has been used by cutting the plate P₀ as the standard according to the desired engine performance in the above-described embodiment, the plate P may be used by selecting a plate closest to the plate P for fulfilling the desired engine performance among plates P prepared in the state of having appropriately set lengths.

[0049] While the plate P has been described to have the shape as shown in Figs. 4(a) to 4(e) in the above-described embodiment, the shape of the plate P is not limited to the shape shown, and may be appropriately selected as far as the shape displays the predetermined functions and effects of the present invention without departing from the gist of the invention.

[0050] The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.